Research on the Evaluation System of Scientific Research Ethics Based on AHP-Fuzzy Comprehensive Evaluation

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Abstract. Scientific research ethics is the value concept and code of conduct to be followed in scientific research, technological development and other scientific and technological activities. However, in recent years, some researchers have ignored ethical constraints in scientific research activities, resulting in more prominent ethical issues in scientific research. This study takes China Southern Power Grid Corporation as an example, based on ISO9000 standards, uses AHP-fuzzy comprehensive evaluation theory to establish a scientific research ethics evaluation system, aiming at improving the timeliness and targeting of scientific research ethics management.

1 Preface

According to the survey report on public awareness of science and technology ethics and safety (2021) [1], 87.5% of medical and health institutions have established ethics committees or ethics review institutions, while the proportion in scientific research institutions and enterprises is very low, only 5.4% and 1.0% respectively. Ignoring the construction of scientific research ethics has led to increasingly prominent ethical problems in scientific research. The construction of evaluation indicators of scientific research ethics is helpful to carry out scientific research ethics management in a standardized manner and reduce the scientific research misconduct. Thus, this study focuses on the construction of scientific research ethics evaluation system, aiming to provide practical reference for scientific research institutions.

2 Basic concepts of scientific research ethics

The Opinions on Strengthening the Governance of Science and Technology Ethics points out that science and technology ethics is the value concept and code of conduct to be followed in carrying out scientific research, technology development and other scientific and technological activities, and is an important guarantee for promoting the healthy development of science and technology. [2] Bao Xinhe, academician of the CAS Member and president of the University of Science and Technology of China, pointed out that "the essence of science and technology ethics is the same as that of scientific research ethics, while the former has a broader scope and pays more attention to the impact of science and technology on society" [3]

Several policies on scientific research ethics have been issued at the national level, such as the Opinions on Further Promoting the Spirit of Scientists and Strengthening the Construction of Style and Style of Study, etc. [4], which fills the gap in the governance system of scientific research ethics in China, but still cannot meet the practical needs. In the new field of scientific research, if the ethical norms are not touched, it will lead to a "huge gap between technology and ethics" [5].

3 Feasibility of introducing ISO9000 standard into scientific research ethics evaluation

ISO9000 is the world's first series of international standards for quality management and quality assurance issued by the International Organization for Standardization (ISO) in 1987. This standard absorbs the quality philosophy of PDCA cycle and adopts international advanced quality management methods, showing universality and strong guidance. Since its inception, more than 160 countries have directly adopted or equivalently converted to corresponding national standards [6]. The introduction of ISO9000 quality certification system is a key step for scientific and technological innovation enterprises to improve the scientific research environment and improve the quality of scientific research.

4 Case analysis

4.1 Company introduction

China Southern Power Grid Co., Ltd. is a super-large state-owned key backbone enterprise related to national

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security and the lifeline of the national economy. In recent years, in order to create a good scientific research atmosphere and ensure the quality and efficiency of the company's scientific research activities, China Southern Network Corporation has issued a series of reform plans for the scientific research system.

4.2 Construction process of scientific research ethics evaluation index system

4.2.1 Fuzzy comprehensive evaluation method based on AHP

AHP-fuzzy comprehensive evaluation method is composed of two parts, namely, analytic hierarchy process and fuzzy comprehensive evaluation method [7]. The fuzzy comprehensive evaluation method based on AHP is a new comprehensive evaluation method based on the full consideration of the advantages of AHP and fuzzy comprehensive evaluation method, which is suitable for solving the problem of uncertain related indicators.

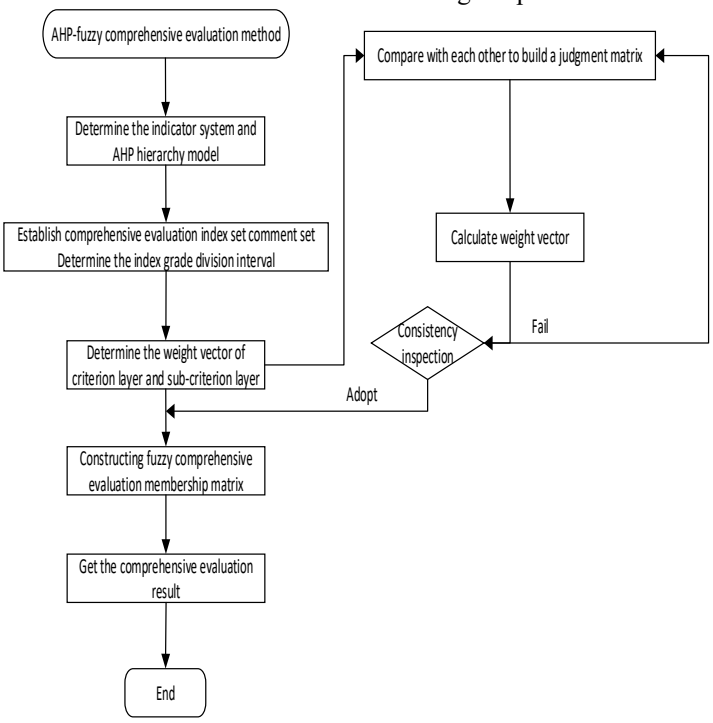

Figure 1. Operational steps of AHP-fuzzy comprehensive evaluation method

4.2.2 Construction process of evaluation system

The fuzzy comprehensive evaluation model based on AHP is as follows:

(1) Determine factor set and comment set

The factor set represents the combination of the evaluation factors of the evaluated object expressed as (1). Comment set refers to the collection of limited fuzzy evaluation indicators (such as excellent, good, medium and poor), which can be expressed as (2).

$$U = (u_1, u_2, \cdots, u_n) \quad (1)$$

$$V = (v_1, v_2, \cdots, v_m) \quad (2)$$

With reference to the ISO 9000 quality management system, this paper selects the evaluation indicators of scientific research ethics, combines the actual situation of the scientific research process of China Southern Power Grid Corporation, and refers to the opinions of relevant experts, and constructs a set of 4 first-level indicators and 12 second-level indicators. As shown in Table 1, the basic framework of scientific research ethics evaluation system has been established.

(2) Determine weight distribution

Each factor in the factor set has different importance, so a certain method must be adopted to evaluate the weight of each factor. AHP is a systematic analysis method for analyzing and calculating the weight of multi-objective decision-making, which is very suitable for index weighting [8]

After hiring several experts to carefully evaluate China Southern Power Grid Corporation, the index weight is calculated according to the principle of AHP through expert scoring.

Table 1 Evaluation framework of scientific research ethics.

Primary index		secondary index	
factor	**weigh t**	**factor**	**weigh t**
Scientific research	0.197	Concept research level	0.377

management responsibility		Construction of responsibility system	0.314
		Education and publicity level	0.353
Scientific research resource management	0.241	Synergy level	0.262
		Synergy level	0.372
		System specifications	0.361
Management of scientific research achievements	0.176	System specifications	0.334
		Reward and punishment mechanism	0.332
		Achievement transform	0.334
Monitoring, analysis and improvement of scientific research quality	0.215	Internal management and evaluation mechanism	0.304
		Supervision and review mechanism	0.311
		Feedback and improvement	0.385

(3) Build membership matrix

In general, the degree of membership indicates the possibility of the evaluation subject to evaluate the evaluated object under the indicators.

The membership vector is expressed as (3),which satisfies (4),whose member matrix is (5).

$$R_i = (\mathrm{r_{i1}}, \mathrm{r_{i2}}, ..., \mathrm{r_{im}}), \mathrm{i} = 1, 2, ..., n \tag{3}$$

$$\sum\nolimits_{j=1}^{m} = 1 \tag{4}$$

$$\widetilde{R} = (\mathrm{R_1}, \mathrm{R_2}, ..., \mathrm{R_n})^{\mathrm{T}} = (r_{ij})_{\mathrm{n\times m}} \tag{5}$$

According to Table 2, we can see the corresponding membership matrix.

$$R_1 = \begin{bmatrix} 0.007 & 0.000 & 0.062 & 0.616 & 0.315 \\ 0.000 & 0.007 & 0.110 & 0.623 & 0.260 \\ 0.000 & 0.096 & 0.390 & 0.397 & 0.116 \end{bmatrix}$$

$$R_2 = \begin{bmatrix} 0.000 & 0.000 & 0.021 & 0.384 & 0.596 \\ 0.000 & 0.000 & 0.007 & 0.336 & 0.668 \\ 0.000 & 0.000 & 0.021 & 0.425 & 0.555 \end{bmatrix}$$

$$R_3 = \begin{bmatrix} 0.000 & 0.233 & 0.521 & 0.240 & 0.007 \\ 0.000 & 0.048 & 0.089 & 0.569 & 0.295 \\ 0.000 & 0.000 & 0.007 & 0.582 & 0.411 \end{bmatrix}$$

$$R_4 = \begin{bmatrix} 0.000 & 0.007 & 0.048 & 0.507 & 0.438 \\ 0.000 & 0.007 & 0.021 & 0.486 & 0.486 \\ 0.000 & 0.041 & 0.130 & 0.589 & 0.240 \end{bmatrix}$$

(4) Calculate comprehensive evaluation results

On the basis of determining the weight vector and membership matrix, the comprehensive evaluation results are calculated and normalized.

$$\tau = \begin{bmatrix} \tau_1 \\ \tau_2 \\ \tau_3 \\ \tau_4 \end{bmatrix} = \begin{bmatrix} 0.002 & 0.038 & 0.189 & 0.539 & 0.232 \\ 0.000 & 0.000 & 0.016 & 0.380 & 0.604 \\ 0.000 & 0.094 & 0.206 & 0.463 & 0.237 \\ 0.000 & 0.020 & 0.071 & 0.532 & 0.377 \end{bmatrix}$$

From the evaluation results of scientific research ethics indicators, 0.2% of scientific research ethics management responsibilities may be very poor, 3.8% may be poor, 18.9% may be medium, 53.9% may be good, and 23.2% may be excellent. According to the principle of maximum subordination, among the five levels of subordination, the proportion of scientific research ethics management responsibility belonging to very excellent is the highest, and the proportion of scientific research achievements management excellent is the lowest. Therefore, China Southern Power Grid Corporation should focus on the construction of scientific research ethics above the management of scientific research achievements.

Table 2. Membership matrix of scentific research ethics

secondary index	**membership matrix**				
	Very poor	**poor**	**Medium**	**good**	**Excellent**
Concept research level	0.007	0	0.062	0.616	0.315
Construction of responsibility system	0	0.007	0.110	0.623	0.260
Education and publicity level	0	0.096	0.390	0.397	0.116
Synergy level	0	0	0.021	0.384	0.596
Synergy level	0	0	0.007	0.336	0.658
System specifications	0	0	0.021	0.425	0.555
System specifications	0	0.233	0.521	0.240	0.007
Reward and punishment mechanism	0	0.048	0.089	0.569	0.295
Achievement transform	0	0	0.007	0.582	0.411
Internal management and evaluation mechanism	0	0.0068	0.048	0.507	0.438
Supervision and review mechanism	0	0.0068	0.021	0.486	0.486

Feedback and improvement	0	0.041	0.130	0.589	0.240

5 Construction of scientific research integrity ethics

In combination with the above analysis, we should improve the management of scientific research achievements, including the final acceptance inspection, the reward and punishment mechanism for scientific research, and the management of achievements transformation, mainly to achieve the following points.

First, it is necessary to clarify the inspection and acceptance norms and standards, establish norms and guidelines for scientific research ethics, make it people-oriented, clarify the scientific research ethics code of conduct of the unit and its partners, and implement the guiding spirit of the Party Central Committee and the State Council on scientific research ethics work. The goal is to establish the scientific research ethics norms and standards, so that the follow-up review and supervision, violation punishment and other mechanisms can be based on, We should guide scientific and technological workers to engage in responsible scientific research and curb all kinds of scientific research misconduct and academic dishonesty.

Second, implement the incentive preference and fault-tolerant mechanism, provide more financial support and autonomy for scientific research subjects with good credit status, and distinguish and deal with the behaviors that violate the scientific research ethics standards due to inadequate study of system documents, deviation of scientific research ethics understanding or unintentional mistakes, and the violations that are indomitable and knowingly committed, through different treatment and different treatment Scientific research subjects with good credit status should be moderately fault-tolerant so that their subsequent assessment and evaluation will not be affected.

The third is to establish the scientific research ethics review and supervision system. The scientific research ethics review and supervision system should cover the whole process without dead ends, especially after the completion of the scientific research project, carry out the post-evaluation of the scientific research project, reward the scientific research project with good ethical performance, give warning punishment to the relevant person in charge of the scientific research project with ethical misconduct, and give warning punishment to the project with serious ethical misconduct, The project leader will be demoted and demerit recorded.

6 Summary

Scientific research ethics is an important guarantee to promote the healthy development of science and technology. The problem of scientific research ethics anomie is a long-term problem to be faced by scientific research activities. It is of key significance to introduce the ISO9000 quality evaluation system into the evaluation index system of scientific research ethics. Based on the AHP-fuzzy comprehensive evaluation method and the actual situation of the construction of scientific research ethics of China Southern Power Grid Corporation, the evaluation index system of scientific research ethics is constructed, and experts are hired to score the relevant indicators. The conclusion is that China Southern Power Grid Corporation should focus on the management of scientific research achievements, and the corresponding guidance is given to improve the scientific research ethics awareness of the majority of scientific research workers and guide the development of science and technology for the better, Improve the quality and efficiency of scientific research, and create a good atmosphere for comprehensively realizing innovation-driven development and supporting scientific research innovation.

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